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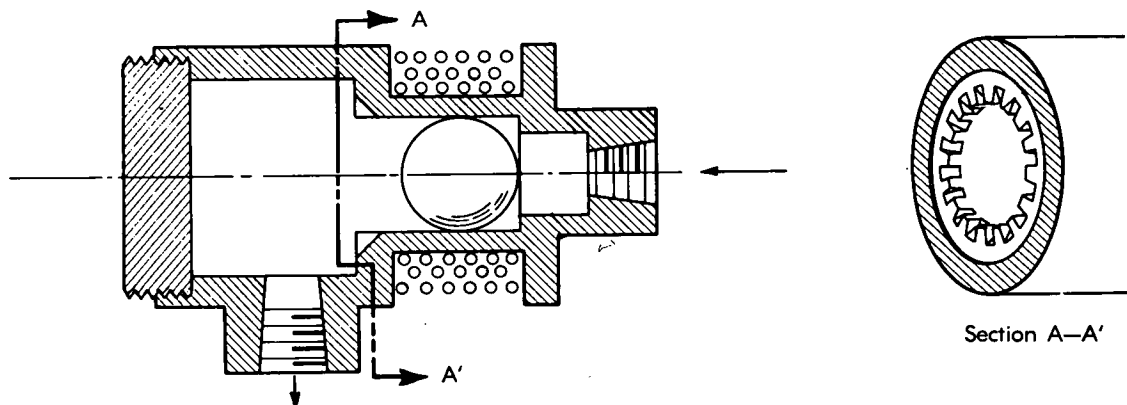
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Thermally Actuated Valve

The problem:

To provide a small, high-reliability, lightweight valve which operates only once to release a pressurized fluid.

port resting on a flat surface. The cylinder is heated in this position by placing it in a hot oven, by energizing the heater, or by some other means. Obviously, when the cylinder is cold, it is too small in diameter



The solution:

An effective seal in a one-shot valve is made by shrink-fitting a ball within a cylinder; thermal expansion of the cylinder, caused by a contiguous source of heat, will release the ball and open the valve.

How it's done:

The valve shown in the diagram consists essentially of a cylindrical body which is shrink-fitted around the ball; when activated, a resistance heater fitted into the recess warms the cylinder and releases the ball. The ends of the cylindrical body are provided with a threaded inlet port and exit port so that the valve can be connected to a fluid dispensing line.

To set up the valve for the first time, the cylindrical body is oriented into a vertical position with the inlet

to permit entry of the ball; however, when the cylinder is hot, thermal expansion has increased its diameter to such an extent that the ball can be dropped in place. The ball normally would fall and be seated on the circular edge near the inlet port; however, the ball in the diagram is purposely set away from the edge to emphasize the fact that hermetic closure occurs at the contact zone between the ball and the cylinder wall. Assembly of the valve is completed when the closure disc is screwed into place.

Assume that the valve is installed in a line and that it is holding back pressurized fluid in the inlet cavity. When it is desired to open the valve, the heater is energized; the cylindrical body expands until it becomes large enough to release the ball. The pressurized fluid ejects the ball into the body cavity, flows

(continued overleaf)

around the sphere and through the exit port. Radial flutes are cut into the circular edge (shown in detail in Section A-A') so that once the valve has been "opened" the ball cannot effect a seal at the upper edge of the cylinder under any conditions of valve orientation or acceleration.

The fact that high stresses can be generated when one member is shrink-fitted around a second member is well known. With proper design and fabrication, the seal produced between the seat and plug is leak-proof; in fact, the valve can be tested easily (while sealed) any number of times without degradation because of the absence of moving parts.

The valve can also be adapted for repeated operation and made capable of being opened without a pressurized fluid. For this configuration, a ball or other suitably configured plug is released from the seat by a prior action of the heater and a compression spring interposed between the ball and the bottom of the cylinder. A bellows brazed into a hole in the assembly closure disc, with a nominal capability of

spring-like action, holds the ball against the circular edge while fluid passes through the radial flutes cut into the circular edge. When it is desired to close the valve, the heater is again energized and a sufficiently great force (provided by a mechanical linkage, pressurized hydraulic fluid, or some other means) is applied through the center of the bellows to overcome the force of the spring and the force (if any) applied to the plug by fluid flowing around it. When it has been determined that the plug is properly located at the seat, the heater is deactivated and, when the seat has cooled, the passageway through the valve will again be sealed.

Patent status:

NASA has decided not to apply for a patent.

Source: Robert H. Silver of
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